Anatomy of Sigma of a Global Intensity-Measure Prediction Model

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We present a scrutiny of the components of uncertainty of our recent predictive model (Cauzzi et al., 2015), with emphasis on their possible dependence on basic model predictors and source region. We follow the standard nomenclature of Strasser et al. (2009) and Al Atik et al. (2016). Our dataset does not support the adoption of a magnitude-dependent σ or model, although there is evidence to suggest that σ of large-magnitude events is lower than that of moderate- and small-magnitude events for vibration periods $T < 3$ s. The distance dependence of $\sigma$ and $\alpha_{ref}$ in our data is unclear, but near-source residuals exhibit comparatively larger variability, especially at intermediate and long periods, most likely due to the absence of near-source terms (e.g., hanging wall, directivity) in our predictive model. The variability of the residuals segregated by ground type is flat, and the residuals on EC8 ground-type A are associated with the lowest spread. The regional dependence of the $\sigma$s residuals in our dataset is small up to intermediate periods, and the offset of regional sub-categorizations with respect to the overall mean of the residuals in practice is equal to zero. $\alpha_{ref}$ and $\alpha_{ref}$ computed based on regressions on at least 4 records are in good agreement with previously published global and regional models, confirming the limited dependence of $\alpha_{ref}$ on source region and ground type. Compared to other studies, our $\sigma$ model is enlarged by Pan-European events to reverse faults. The contribution to $\sigma$ of poorly recorded events (with less than three records) is effectively minimised by the weighting scheme of Joyner and Boore (1993 and 1994) that we used to develop our predictive equations.

#### (1) Within-event uncertainty component $\sigma = \text{st.dev.}(\Delta w)$

Within-event uncertainty component, $\sigma$ of Cauzzi et al. (2015) — CE1A5 — compared to that of other global (Campbell and Bozorgnia, 2014 - CB14) and regional (Bindi et al., 2014 - BEA14) and regional (Bindi et al., 2014 - BEA14), Zhao et al., 2006 - ZEA06) studies. Note that $\sigma$ of CB14 is modelled as heteroscedastic with respect to $M_w$.

#### (2) Between-events uncertainty component $\tau = \text{st.dev.}(\Delta b^*)$

Between-events uncertainty component, $\tau$ of Cauzzi et al. (2015) — CE1A5 — compared to that of other global (Campbell and Bozorgnia, 2014 - CB14) and regional (Bindi et al., 2014 - BEA14), Zhao et al., 2006 - ZEA06) studies. Note that $\tau$ of CB14 is modelled as heteroscedastic with respect to $M_w$.

#### (1.1) Single-site $\Delta \sigma = \text{st.dev.}(\Delta w)$

Single-site $\Delta \sigma = \text{st.dev.}(\Delta w)$ of $\sigma$ of CE1A5 based on subpopulations of $\Delta w_s$ with at least 30 data. Data from New Zealand are actually representative of the Canterbury Plains only.

#### (2.1) Focus on region and SOF dependence of $\tau$

Total $\tau$ of CE1A5 compared with the weighted average deviation $\tau_{avg}$ of the between-events residuals sorted by region (Japan and Pan-European) and style-of-faulting. Out of nine reverse-fault events, only two Iranian earthquakes were already included in the CB14 dataset. The remaining seven all pertain to the 2012 Emilia (Northern Italy) seismic sequence, that is apparently playing a significant role in inflating $\tau_{avg}$ of CE1A5 at intermediate and long periods. It is likely that the strong site response like, e.g., complex basin effects in the Po alluvium plain not modelled in the first stage of the regressions, are propagated in the subsequent stages and are inflating $\tau_{avg}$. The focus on the region and SOF dependence of the $\tau_{avg}$ of the event terms of the Emilia sequence. It is proposed as alternative $\tau$ model for CE1A5.